AMENDMENT

Amendments to the Claims

A complete listing of the claims follows. In response to the Restriction Requirement, Applicants elect, without traverse, to prosecute Group I (claims 1-55 and 58). Therefore, please cancel claims 56-57 as indicated below without prejudice to Applicants' right to pursue their subject matter in this application or in a related application. This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Previously presented) A pipeline inspection system comprising,

a wave launcher in communication with a pipeline and adapted to transmit an input waveform having a selected input energy along a longitudinal axis inside said pipeline, and to receive a reflected component of said input waveform from said pipeline, said reflected component having a characteristic reflected energy,

an analyzer in communication with said wave launcher and adapted to generate said input waveform, and to receive said reflected component of said input waveform from said wave launcher, and

a processor in communication with said analyzer and adapted to compare said input waveform with said reflected component of said input waveform to determine a characteristic of said pipeline,

wherein the wave launcher, the analyzer, and the processor operate in a fashion that is non-invasive to the pipeline.

2. (Original) The apparatus of claim 1, wherein said processor is further adapted to compare said input waveform with said reflected component to detect an anomaly in said pipeline.

3. (Original) The apparatus of claim 2, wherein said anomaly is at least one of a crack, a corrosion, a leak, a location of an end wall, an obstruction, a flange, a weld, and a restriction in said pipeline.

4. (Original) The apparatus of claim 2, wherein said processor is further adapted to compare said input waveform with said reflected component to determine a location of said anomaly in said pipeline.

5. (Original) The apparatus of claim 2, wherein said processor is further adapted to compare said input waveform with said reflected component to determine a shape of said anomaly in said pipeline.

6. (Original) The apparatus of claim 2, wherein said processor is further adapted to compare said input waveform with said reflected component to determine one of an absolute size of said anomaly and a relative size of said anomaly relative to an internal diameter of said pipeline.

7. (Original) The apparatus of claim 1, wherein said processor is further adapted to compare said input waveform with said reflected component to determine an axial curvature in said pipeline.

8. (Original) The apparatus of claim 1, wherein said processor is further adapted to compare said input waveform with said reflected component to determine location points along said pipeline relative to an initial known location.

9. (Original) The apparatus of claim 1, wherein said wave launcher further comprises a probe antenna, said probe antenna adapted for transmitting said input waveform into said pipeline.

10. (Original) The apparatus of claim 9, wherein said probe antenna of said wave launcher is in physical contact with said pipeline.

11. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to detect said reflected component along said longitudinal axis of said pipeline.

12. (Original) The apparatus of claim 1, wherein said processor is further adapted to generate a mathematical model representative of said pipeline.

13. (Original) The apparatus of claim 12, wherein said mathematical model is ideal.

14. (Original) The apparatus of claim 12, wherein said mathematical model is lossy.

15. (Original) The apparatus of claim 12, wherein said mathematical model is one of an averaging model and a cross-sectional model.

16. (Original) The apparatus of claim 12, wherein said processor is further adapted to generate a model transfer function relating a model input waveform to a model reflected component, an actual transfer function relating an actual input waveform to an actual reflected component, and to determine said characteristic at least in part by comparing said model transfer function with said actual transfer function.

17. (Original) The apparatus of claim 12, wherein said processor is further adapted to determine said characteristic of said pipeline at least in part by comparing an actual reflected component with a model reflected component.

18. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to extract a characteristic energy and phase for said input waveform and said reflected component.

19. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to generate said input waveform with a frequency above a characteristic cutoff frequency of said pipeline.

20. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to generate said input waveform at a frequency within a range of frequencies for which a dominant mode for said pipeline exists.

21. (Original) The apparatus of claim 20, wherein said input waveform comprises a plurality of input signals within said range of frequencies.

22. (Original) The apparatus of claim 21, wherein said analyzer is further adapted to detect differences in velocity between said plurality of input signals as said input signals propagate in said pipeline, and said processor is further adapted to determine a curvature of said pipe along said longitudinal axis from said differences in velocity.

23. (Original) The apparatus of claim 21, wherein said analyzer is further adapted to detect differences in velocity between reflected components of each of said plurality of input signals to determine a curvature of said pipeline along said longitudinal axis.

24. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to generate an electromagnetic waveform as said input waveform.

25. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to generate an acoustic waveform as said input waveform.

26. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to generate said input waveform as one of a spread spectrum waveform, a chirp waveform, and a soliton waveform.

27. (Original) The apparatus of claim 1, wherein said analyzer is further adapted to generate said input waveform as a wideband waveform.

28. (Original) The apparatus of claim 1 further comprising calibration elements adapted to temperature stabilize said analyzer

29. (Previously presented) A method of inspecting a characteristic of a pipeline, said method comprising,

transmitting an input waveform having a selected input energy along a longitudinal axis inside said pipeline,

receiving a reflected component of said input waveform from said pipeline, said reflected component having a characteristic reflected energy, and

comparing said input waveform with said reflected component of said input waveform to determine said characteristic of said pipeline,

wherein the transmitting, receiving, and comparing steps occur in a fashion that is non-invasive to the pipeline.

30. (Original) The method of claim 29 further comprising, comparing said input waveform with said reflected component to detect an anomaly in said pipeline.

31. (Original) The method of claim 30, wherein said anomaly is at least one of a crack, a corrosion, a leak, a location of an end wall, an obstruction, a flange, a weld, and a restriction in said pipeline.

32. (Original) The method of claim 30 further comprising, comparing said input waveform with said reflected component to determine a location of said anomaly in said pipeline.

33. (Original) The method of claim 30 further comprising, comparing said input waveform with said reflected component to determine a shape of said anomaly in said pipeline.

34. (Original) The method of claim 30 further comprising, comparing said input waveform with said reflected component to determine one of an absolute size of said anomaly and a relative size of said anomaly relative to an internal diameter of said pipeline.

35. (Original) The method of claim 29 further comprising, comparing said input waveform with said reflected component to determine an axial curvature in said pipeline.

36. (Original) The method of claim 29 further comprising, comparing said input waveform with said reflected component to determine location points along said pipeline relative to an initial known location.

37. (Original) The method of claim 29, further comprising, detecting said reflected component along said longitudinal axis of said pipeline.

38. (Original) The method of claim 29 further comprising, generating a mathematical model representative of said pipeline.

39. (Original) The method of claim 38, wherein said mathematical model is ideal.

40. (Original) The method of claim 38, wherein said mathematical model is lossy.

41. (Original) The method of claim 38, wherein said mathematical model is one of an averaging model and a cross-sectional model.

42. (Original) The method of claim 38 further comprising, generating a model transfer function relating a model input waveform to a model reflected component, an actual transfer function relating an actual input waveform to an actual reflected component, and to determine said characteristic at least in part by comparing said model transfer function with said actual transfer function.

43. (Original) The method of claim 38 further comprising, determining said characteristic of said pipeline at least in part by comparing an actual reflected component with a model reflected component.

44. (Original) The method of claim 29 further comprising, extracting a characteristic energy and phase for said input waveform and said reflected component.

45. (Original) The method of claim 29 further comprising, generating said input waveform with a frequency above a characteristic cutoff frequency of said pipeline.

46. (Original) The method of claim 29 further comprising, generating said input waveform at a frequency within a range of frequencies for which a dominant mode for said pipeline exists.

47. (Original) The method of claim 46, wherein said input waveform comprises a plurality of input signals within said range of frequencies.

48. (Original) The method of claim 47 further comprising, detecting differences in velocity between said plurality of input signals as said input signals propagate in said pipeline, and determining a curvature of said pipe along said longitudinal axis from said differences in velocity.

49. (Original) The method of claim 47 further comprising, detecting differences in velocity between reflected components of each of said plurality of input signals to determine a curvature of said pipeline along said longitudinal axis.

50. (Original) The method of 29 further comprising, generating an electromagnetic waveform as said input waveform.

51. (Original) The method of claim 29 further comprising, generating an acoustic waveform as said input waveform.

52. (Original) The method of claim 29 further comprising, generating said input waveform as one of a spread spectrum waveform, a chirp waveform, and a soliton waveform.

53. (Original) The method of claim 29 further comprising, generating said input waveform as a wideband waveform.

54. (Original) The method of claim 29 further comprising, calibrating said analyzer to be temperature stable.

55. (Previously presented) A method of determining a location of a point along a pipeline, said method comprising,

transmitting an input waveform having a selected input energy along a longitudinal axis inside said pipeline,

receiving a reflected component of said input waveform from said pipeline, said reflected component having a characteristic reflected energy, and

comparing said input waveform with said reflected component of said input waveform to determine said location of said point along said pipeline,

wherein the transmitting, receiving, and comparing steps occur in a fashion that is non-invasive to the pipeline.

56. (Canceled)

57. (Canceled)

58. (Previously Presented) A method of inspecting a characteristic of a pipeline, said method comprising,

generating an input waveform,

launching said input waveform along a longitudinal axis inside said pipeline,

receiving from said pipeline a reflected component having a characteristic reflected energy of said input waveform,

calculating a mathematical function of said characteristic reflected energy from said reflected component of said input waveform,

determining a model mathematical function of model reflected energy from a model component of a model input waveform, and

determining said characteristic of said pipeline by comparing said mathematical function of said reflected energy to said model mathematical function of said model reflected energy,

wherein each step is performed in a fashion that is non-invasive to the pipeline.

RESPONSE

Claims 1-58 were pending in the Application. Claims 1-4, 6, 8-14, 16-18, 24-27, 29-32, 34, 36-40, 42-44, 50-53, 55 and 58 are rejected. Claims 5, 7, 15, 19-23, 28, 33, 35, 41, 45-49, and 54 are objected to.

The undersigned wishes to thank the Examiner for his time and courtesy during the telephonic interview that took place on October 21, 2003. The following discussion is intended to constitute a proper recordation of such interview in accordance with MPEP §713.04, and also to provide a full response to the Office Action mailed on July 16, 2003.

The Claims as Amended Are Patentably Distinct Over the Cited Reference

Independent claims 1, 29, 55, and 58 are rejected under 35 U.S.C. 102(a) as being anticipated by Japanese Patent No. 411270800A by Akihiko (hereinafter "Akihiko"). For the reasons that follow, Applicants respectfully traverse this rejection.

As discussed in the October 21 interview, Akihiko does not teach or suggest inspecting a pipeline in a fashion that is non-invasive to the pipeline, as recited in independent claims 1, 29, 55, and 58. Instead, Akihiko teaches an invasive inspection technique. In particular, and as set forth at page 9, paragraph [0042] of Akihiko, the reference teaches positioning two microphones separately within a diagnosis interval of a pipe arrangement. The microphones measure the sound pressure of a sound wave transmitted within the pipeline. Akihiko therefore suggests an *invasive* technique to inspect the pipeline rather than a non-invasive technique, as recited in independent claims 1, 29, 55, and 58.

Additionally, Akihiko does not teach or suggest comparing the input waveform with the reflected component of the input waveform to determine a characteristic of the pipeline. Instead, Akihiko teaches measuring a property of the generated acoustic wave from the sound pressure in the pipe at independent microphones. (Page 6, paragraphs [0020] – [0022], FIG. 1.) In particular, Akihiko suggests that the acoustic wave is detected by the microphones and the property of the acoustic wave is determined from the sound pressure detected by these microphones. (Page 6, paragraph [0020], FIG. 1.) The pipe arrangement is then determined

from the measured property of the acoustic wave. (Page 6, paragraph [0022].) Therefore, Akihiko does not teach or suggest comparing the input waveform with the reflected component of the input waveform to determine a characteristic of the pipeline, as recited in independent claims 1, 29, 55, and 58.

Consequently, Applicants respectfully request reconsideration and withdrawal of the rejection of the independent claims over Akihiko. Further, as claims 1-28 and 30-54 depend from claims 1, 29, and 55, respectively, and recite further limitations thereon, Applicants respectfully submit that these claims are allowable as well.

CONCLUSION

In view of the foregoing, Applicants respectfully request that the Examiner pass claims 1-58 to allowance. The Examiner is invited to contact Applicants' undersigned representative by telephone at the number listed below to discuss any outstanding issues.

Respectfully submitted,

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